

REMARKS

Claims 1-66 are all the claims pending in the application. Claims 56-63 have been withdrawn from further consideration as being drawn to a non-elected invention.

I. Drawings:

The Examiner objects to the drawings because the piezoelectric element is not metal, but it is shaded as such. Applicants will submit new formal drawings, overcoming the raised drawing objection, once this application is otherwise placed in a condition for allowance.

The Examiner also objects to the drawings because they do not show the features set forth in claims 4 and 5. With respect to claim 4, the recited features are depicted in Fig. 24. In Fig. 24, the compression film is a conductive film 65 that is located between the lower electrode 60 and the piezoelectric layer 70. Claim 5 (which depends from claim 4) recites that the conductive film 65 contains a first conductive film and a second conductive film. This feature is described in the specification (p. 26, l. 36-39). Applicants submit new Fig. 24(c)', which illustrates this feature. Also, Applicants appropriately amend the specification to make reference to new Fig. 24(c)'.

The Examiner asserts that Figs. 7(a) and 7(b) should be designated by a --Prior Art-- legend. However, these figures were prepared by Applicants in connection with the instant application to facilitate the understanding of the present invention. They are described in the specification as showing a "conventional" device. However, the device is known "in-house" only, and Figs. (7a) and 7(b) have not been published or otherwise made available to the public

in such a way as to make them qualify as prior art under any subsection of 35 U.S.C. § 102. Consequently, there is no need to amend Figs. 7(a) and 7(b) as suggested by the Examiner.

II. Specification:

The Examiner objects to the title of the invention because it is not descriptive of the invention. Applicants amend the title to recite --a compressive film--. The amended title is believed to address the Examiner's concerns. If not, however, Applicants look forward to receiving any proposed title amendments that the Examiner may care to make.

III. Rejections Under 35 U.S.C. § 112, 2nd Paragraph:

The Examiner rejects claims 1-55 and 64-66 under 35 U.S.C. § 112, 2nd paragraph, because the structure is unclear, several elements are not positively recited, and the claims contain numerous inconsistencies.

Applicants clarify the structure of the invention by numbering the elements listed in the preamble of claim 1. Applicants also deleting the first recitation of "comprising" in favor of --of the type having-- to emphasize that several elements are listed in the preamble of the claim (not the body). Claim 1 requires only a single element ... *i.e.*, a compression film. In various embodiments of the invention, the compression film forms different parts of the ink jet recording head, including for example: the elastic film 50 (Fig. 6); the lower electrode 60 (Figs. 16); the upper electrode 80 (Figs. 18); and the conductive film 65 (Fig. 24). These different embodiments of the invention are defined by the dependent claims in a consistent fashion. They are not internally inconsistent as alleged by the Examiner. If the Examiner maintains that the

claims are internally inconsistent, then she should at least point out the specific language that she deems objectionable.

The amended claims are believed to more particularly point out and distinctly claim the subject matter regarded as the invention, thereby overcoming all of the raised rejections under § 112, 2nd paragraph.

IV. Rejections on Prior Art Grounds:

The Examiner rejects claims 1-55 and 64-66 under 35 U.S.C. § 103(a) as being obvious over US 5,719,607 to Hasegawa et al. ("Hasegawa '607") in view of US 5,530,465 to Hasegawa et al. ("Hasegawa '465"). Applicants respectfully traverse this rejection position in view of the following remarks.

The Present Invention

The present invention relates to an ink jet recording head for jetting ink drops via the displacement of a piezoelectric element. With reference to Fig. 2, the ink jet recording head is of the type having a flow passage formation substrate 10 in which a pressure generation chamber 12 and a nozzle opening 11 are formed. A diaphragm 50 is provided on the flow passage formation substrate 10. The diaphragm 50 defines an interior wall of the pressure generation chamber 12. A piezoelectric element 300 is provided on the diaphragm 50. The piezoelectric element 300 has a lower electrode 60, a piezoelectric layer 70, and an upper electrode 80.

As recited in claim 1, an important feature of the present invention is that the ink jet recording head includes a compression film having (1) a compressive stress and (2) at least a part in

a thickness direction removed in an area opposed to the pressure generation chamber 12, thereby forming a removal part. The compression film may form a variety of elements in the ink jet recording head depending on the particular embodiment. For example, Fig. 6 shows the compression film forming the elastic wall 50 (or diaphragm), Fig. 16 shows the compression film forming the lower electrode 60, Fig. 18 shows the compression film forming the upper electrode 80, and Fig. 24 shows the compression film forming the conductive film 65.

Hasegawa '607

With reference to Fig. 2, Hasegawa '607 discloses a liquid jet head in which a substrate 101 is provided with a chamber 102. A diaphragm 103 is provided on the substrate 101. A tantalum layer 203 is provided on the diaphragm 103. And a piezoelectric device is provided on the tantalum layer 203. The piezoelectric device includes a lower electrode 104, a piezoelectric film 105, and an upper electrode 106.

Hasegawa '465

With reference to Fig. 2A-2B, Hasegawa '465 discloses a liquid jet head having a substrate 101 with opposing silicon oxide layers 201. A diaphragm 103 is formed on one side of the substrate 101. And a piezoelectric device is formed on the diaphragm 103. The piezoelectric device includes a lower electrode 104, a piezoelectric film 105, and an upper electrode 106. As shown in Fig. 2C, an opening 102 is formed through the substrate 101 and the silicon oxide layer 201 interposing between the diaphragm 103 and substrate 101.

Analysis

The Examiner asserts that Hasegawa '607 teaches all of the features set forth in claim 1, except for the compression film having a removal part, and therefore looks to Hasegawa '465 to allegedly teach this feature. The Examiner's rejection position is incorrect for several reasons.

Hasegawa '607 does not teach the features upon which the Examiner relies to reject the claims. Namely, Hasegawa '607 does not provide the compression film defined by claim 1. The Examiner apparently compares any one of the main vibrating diaphragm 202 (Fig. 2), the first intermediate layer 210 (Fig. 3), or the second intermediate layer 220 (Fig. 4) of Hasegawa '607 to the compression film of the present invention. Importantly, however, Hasegawa '607 does not indicate that any of these layers 202, 210, 220 have a compressive stress. In this respect, the Examiner's position is speculative. Of course the Examiner may be relying upon an inherency theory, but if this were the case, then she should have at least set forth a cogent line of technical reasoning as to why the relied upon layers in Hasegawa '607 would necessarily have a compressive stress. In this case, the Examiner has not provided any reasoning whatsoever. At least in this respect, the Examiner has not even established a *prima facie* case of obviousness.

Moreover, the specification indicates that the compressive stress is achieved via specific processing steps. For example, when the compression film forms the elastic film 50, a zirconium layer is formed on the substrate by sputtering, and then thermal oxidation processing occurs in oxygen at a high temperature to achieve a monoclinic system. During oxidation, the zirconium is heated to a phase transition temperature or more. Therefore, when cooled, a transition occurs

resulting in the zirconium oxide having a compressive stress.¹ The specification also provides the processing details to achieve the compressive stress when the compression film forms other layers in the ink jet recording head.²

By sharp contrast to the present invention, Hasegawa '607 does not indicate any specific processing steps that would lead to a compressive stress in the main vibrating diaphragm 202, the first intermediate layer 210, or the second intermediate layers 220. Rather, Hasegawa merely indicates the locations of these layers 202, 210, 220, their respective functions (which do not include providing a compressive stress), and exemplary materials that may be used to form the layers. Certainly then, the compressive stress feature defined by claim 1 is not taught or suggested by Hasegawa '607. The Examiner's assertions to the contrary are simply unfounded.

Hasegawa '465 does not make up the deficiencies of Hasegawa '607 noted above with respect to claim 1.

For these reasons, Applicants respectfully assert that claim 1 is patentable, and that claims 2-55 and 64-66 are patentable at least by virtue of their dependency.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

¹ Specification, paragraph bridging p. 13-14.


² When the compression film forms the lower electrode 60, see p. 21, 1st paragraph. When the compression film forms the upper electrode 80, see p. 22, 5th and 6th paragraphs.

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Appln. No. 09/199,816 (Q52241)

Applicants hereby petition for any extension of time which may be required to maintain the pendency of this case, and any required fee, except for the Issue Fee, for such extension is to be charged to Deposit Account No. 19-4880.

Respectfully submitted,

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APPENDIX
VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE TITLE:

The title is changed as follows:

INK JET RECORDING HEAD AND INK JET RECORDER HAVING A
COMPRESSION FILM WITH A COMPRESSIVE STRESS AND REMOVAL PART
INCORPORATED THEREIN

IN THE SPECIFICATION:

The specification is changed as follows:

Page 10, seventeenth full paragraph:

FIGs. [22(a)-22(c)] 22(a)-22(c)' are plan and sectional views of the main part of an ink jet recording head according to a twelfth embodiment of the invention;

Page 26, sixth full paragraph:

In the embodiment, the conductive film 65 is formed of one layer, but the invention is not limited to it[; for]. For example, as shown in Fig. 24(c)', the conductive film 65 may be formed of two layers 65a, 65b. In this case, preferably each of the two layers has a compressive stress, but the invention is not limited to it; at least the upper layer 65a may have a compressive stress.

IN THE CLAIMS:

The claims are amended as follows:

1. (Amended) An ink jet recording head [comprising] of the type having (1) a flow passage formation substrate in which a pressure generation chamber[s communicating with] and a nozzle opening[s are defined and a piezoelectric element being placed on one side of said flow passage formation substrate via] are formed, (2) a diaphragm provided on said flow passage formation substrate, said diaphragm defining an interior wall of said pressure generation chamber, (3) a piezoelectric element provided on said diaphragm, said piezoelectric element [and] having at least a lower electrode, a piezoelectric layer, and an upper electrode, said ink jet recording head comprising:

a compression film having (1) a compressive stress and (2) at least a part in a thickness direction removed in [at least a part of] an area opposed to [the] said pressure generation chamber, thereby forming a removal part.